1.0 GENERAL

This product Specification describes the Mechanical, Electrical, Environmental, Reliability and Safety Requirements for a double sided, micro-flexible disk drive. This 3.5 inch disk drive shall be designed and manufactured for use as an internal peripheral device for the Commodore C65 series of computers. The flexible disk drive as described herein shall be purchased as an OEM product.

1.1 APPLICABLE DOCUMENTS

Commodore Engineering Policy 1/02.010; OEM Environmental Requirements.

UL 478/114; Electronic Data processing Units and Systems.

CSA 22.2 Data processing Equipment #143 and #154 Consumer and Commercial Products.

Commodore/Amiga FDD EMI Susceptibility Test Procedure TP009

FCC Part 15 subpart J Class B computing equipment

1.2 GENERAL DESCRIPTION

Features shall include simple, accurate head positioning, a direct drive, brushless DC motor equipped with an accurate chucking mechanism and simple spindle for smooth rotation. This flexible disk drive shall be compatible with standard 3.5 Inch flexible disk drives and data media.

COMMODORE P. N.	STATUS					
313372-01	ACTIVE					

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.
TOLERANCES:
ANGLES +/- 1 DEGREE
2 PLACE DECIMALS +/- 0.02
3 PLACE DECIMALS +/- 0.010

	DATE	
DRAWN Mike Rivers		**Commodore**
SYSTEM ENG.	DATE	
TEST ENG	DATE	1200 WILSON DRIVE WEST CHESTER, PA. 19380 (215) 431-9100
COMP. ENG Drew Shannon	DATE	TITLE:
CIRCUIT ENG.	DATE	FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH

SIZE A	DRAWING NUMBER 313372
SCALE	SHEET 1 OF 21

Refer to table 1 - General Requirements.

1.3 FUNCTIONAL DESCRIPTION

1.3.1 Read/Write and Control Electronics
The read/write mechanism shall consist of two (2) read/write heads, a head position actuator drive and an elevator assembly. The control electronics shall include read/write amplifier and transition detector, control logic, side select circuits, write protect circuits and spindle motor/drive control circuits. The logic in the drive shall prevent the head from stepping outward when it is on the zero track. This device shall have no index detector.

1.3.2 Drive Mechanism

The 300 RPM spindle is powered by a direct drive, brushless DC motor under the control of the servo speed circuitry. A magnetic chucking device in conjunction with a stainless steel hub on the media shall provide precise media positioning. A mechanical interlock shall insure proper media insertion.

1.4 RESTRICTIONS

The internal housekeeping logic and mechanical operation may vary between Vendors, provided the requirements of this specification are attained.

1.5 ALIGNMENT

Using Dysan Analog Alignment diskettes (350/2A) or equivalent. Alignment test should be preformed at 25°C +/- 5% with a relative humidity of 50% +/- 5%. The test procedure is outlined in the drive exerciser manuals. The following limits shall apply:

RADIAL ALIGNMENT	±25 μm
INDEX to BURST	400μs (tol: +/-200μs)
2F/1F SIGNAL AMPLITUDE	50%
AZIMUTH	+/-30 minutes max.

1.6 EMI SUSCEPTIBILITY TEST (as per Commodore Qualification Test Procedure TP009)

1.6.1 READ MARGIN:

A floppy drive tester shall be used while reading and recording in the READ (Window) margin on tracks 00, 40, and 79. The CRT simulator coil shall be held 1" from the drive in worst case location. Refer to test procedure TP009 for details.

1.6.2 SEEK TEST:

Refer to test procedure TP009 for details.

Commodore	TITLE		
		FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH	

| SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 2 OF 21
	313372	1		

TABLE 1

Media (floppy disk):	Industry standard, 90 mm (3.5"), DS/DD medium
Heads: READ/WRITE	Two (2): One Head, Each Side
Tracks:(note 1)	160 (MIN)
Cylinders:	80 (MIN)
Density (unformatted)	
DISK:	1 M bytes
TRACK:	6.25 K bytes
Encoding Method:	MFM (Modified FM)
Encoding Density:	8717 BPI (bits per inch)
Data Transfer:	250 K BPS (bits per second)
Track-to-Track seek time:	3 milliseconds (min)
HEAD Settling Time (after step):	18 milliseconds (max)
Rotation Speed:	300 RPM
Long-Term Speed Variation:	Less than +/- 1.5 %
Instantaneous Speed Variation:	+/- 1.5 % ISV Average (see note 3)
Track Radius:	
OUTSIDE (00) -	Side 0 = 39.5 mm, Side 1 = 38.0 mm
INSIDE (79) -	Side 0 = 24.6875 mm, Side 1 = 23.1875 mm
Index Quantity:	One (1)
Track Density:	135 TPI
Window Margin:	Greater than 800 nanoseconds on 'Specified Test Track MFM' Method; PLO Separator and Zero Write Compensation
Overwrite Ratio (TRACK 0):	- 26 dB Signal Level after Erasure
Seek Time	3 ms (Track to Track)
Settling Time	15 ms
Motor On Time (note 2)	500 ms
Motor on to Ready	1 sec (max)

1- While the disks are formatted for 160 cylinders on 80 tracks (0 to 79) the drive must allow access to tracks 80 and 81.

2- Time Required for the motor to reach the normal operating speed after startup.

3- Instantaneous speed variation may be higher, provided the result of Average Speed Variation and Instantaneous Speed Variation does not exceed 3%.

Commodore		TITLE		
		FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH		
SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 3 OF 21
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Control Signals Timing

POWER (+5V)

MOTOR ON
(MON)

DRIVE SELECT
(DS)

READY
(RDY)

TRACK 00
(TK00)

INDEX
(IDX)

INDEX SENSOR

DIRECTION
(DRTN)

STEP
(STP)

WRITE GATE
(WTG)

SIDE SELECT
(SSL)

READ DATA
(RDD)

100 msec (min)

1 μsec (max)

1 sec (max)

0.5sec (max)

1 μsec (min)

Valid

Inhibited — Valid

1 μsec (min)

1 μsec (min)

2 msec (max)

18 msec (min)

1 msec (min)

1 μsec (min)

100 μsec (min)

100 μsec (min)

500 ms (max)

Valid

Inhibited — Valid
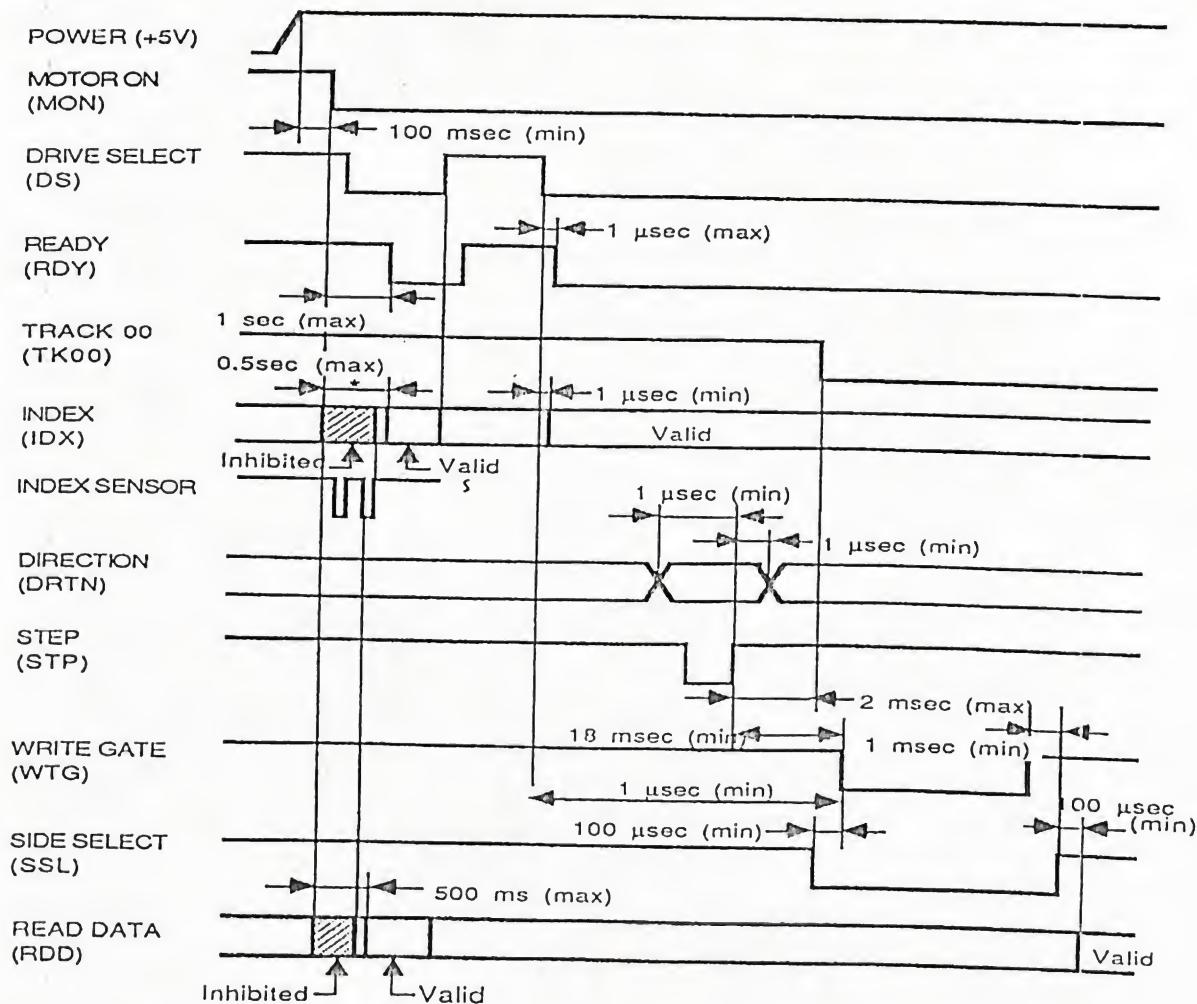
•   Since the IDX pulse cycle is 0.2 sec., valid pulses of the IDX signal are only
    output after 0.7 sec. (max) has elapsed. [0.5 + 0.2 = 0.7 sec.]

Control Signals Timing (When a cartridge is already inserted)

FIGURE 1
CONTROL TIMING

	Commodore		TITLE	
			FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH	
SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 4 OF 21
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Read Start Timing

DRIVE SELECT
(DS)

STEP
(STP)

1 µsec (min)   100 µsec (min)

WRITE GATE
(WTG)

18 msec (min)

READ DATA
(RDD)   Valid   Valid

1 msec (min)

1 µsec (min)

SIDE SELECT
(SSL)

Read Start Timing

Read Data Timing

4 µsec (nom)   8 µsec (nom)   6 µsec (nom)

0.3 µsec ±0.1 µsec
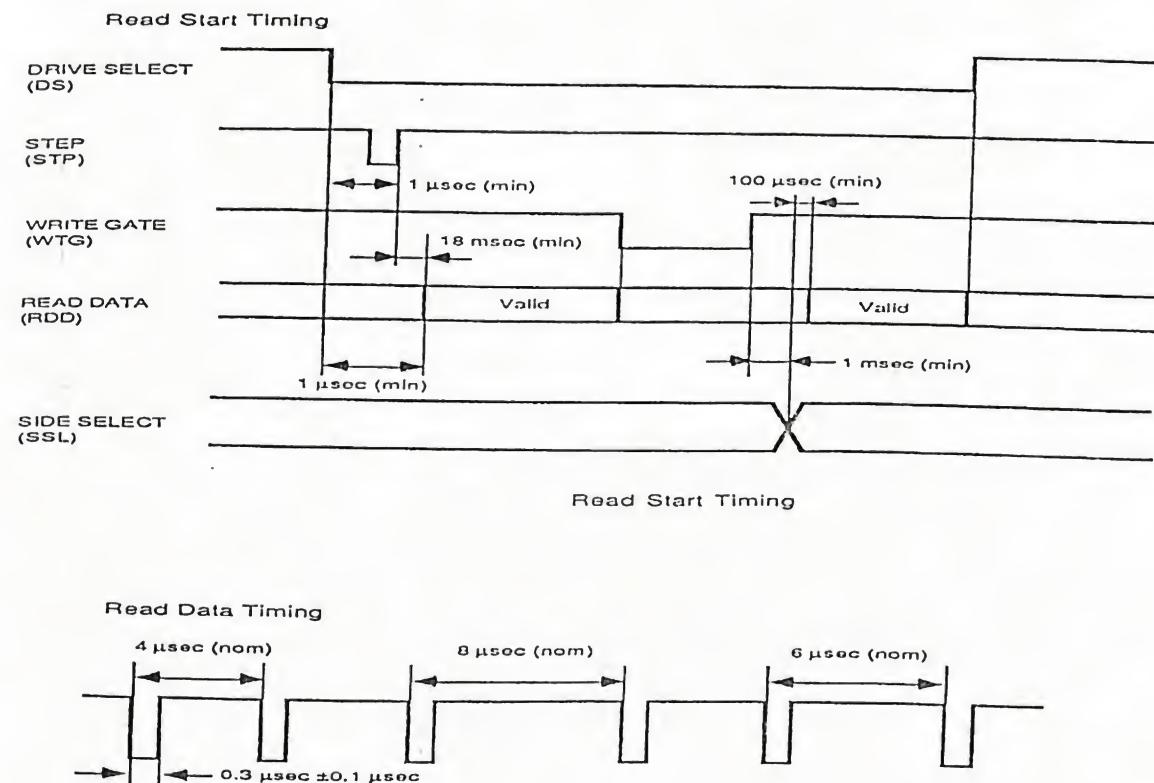
FIGURE 2
READ TIMING

Commodore		TITLE		
		FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH		
SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 5 OF 21
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Write Start Timing

DRIVE SELECT
(DS)

STEP
(STP)

WRITE GATE
(WTG)

WRITE DATA
(WTD)

SIDE SELECT
(SSL)

1 µsec (min)

1 µsec (min)

1 µsec (min)

18 msec (min)

1 msec (min)

1 µsec (min)

8 µsec (max)
1 µsec (min)

1 msec (min)

100 µsec (min)
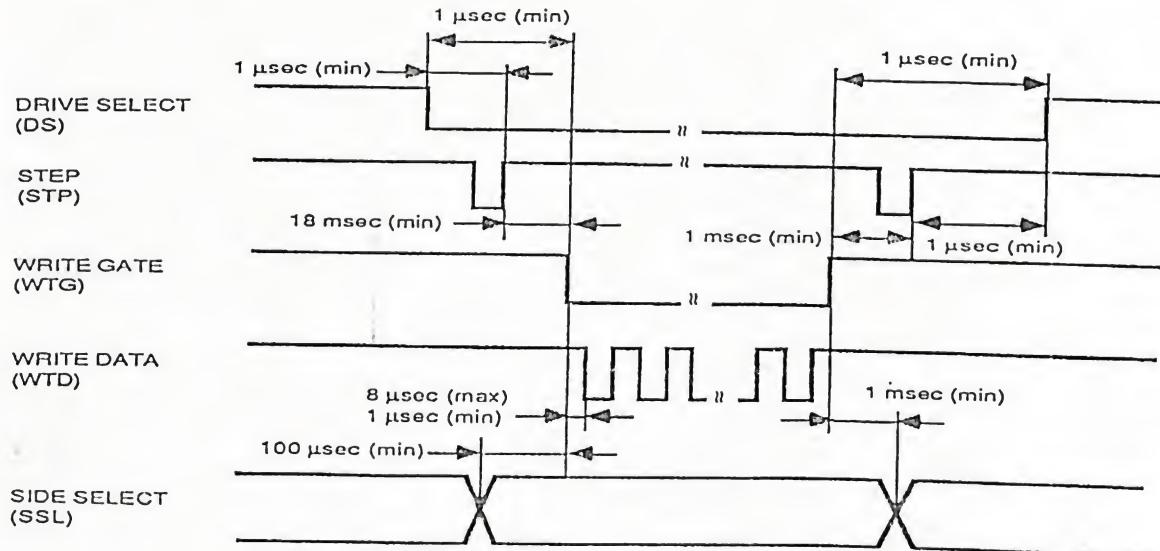
Write Start Timing

Write Data Timing

4 µsec ±20 nsec

8 µsec ±40 nsec

6 µsec ±30 nsec

0.15 µsec (min)
2 µsec (max)
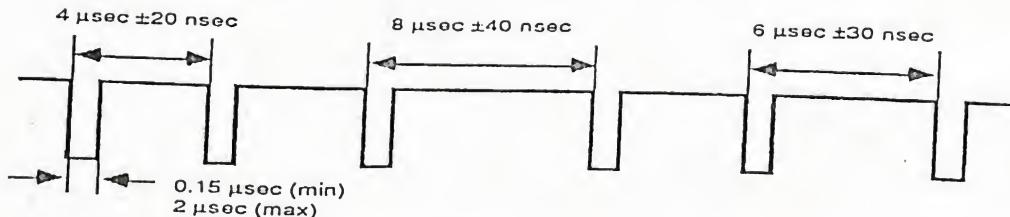
Write Data Timing   (Without write precompensation)

FIGURE 3
WRITE TIMING

Commodore		TITLE		
		FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH		
SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 6 OF 21
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2.0 PHYSICAL REQUIREMENTS

2.1 PHYSICAL PARAMETERS

The FDD shall conform to the physical Mounting Locations and Dimensional Parameters as illustrated in Figure 5.

2.2 WEIGHT

Unit Weight shall not exceed 615 grams.

2.3 CABINET
Enclosure, not required.

2.4 CONTROLS and INDICATORS

2.4.1 Control Button - Eject

The Eject Button shall be accessible from the front of the disk drive for easy operator actuation. Refer to Section 2.1 (physical Parameters), for the required location.
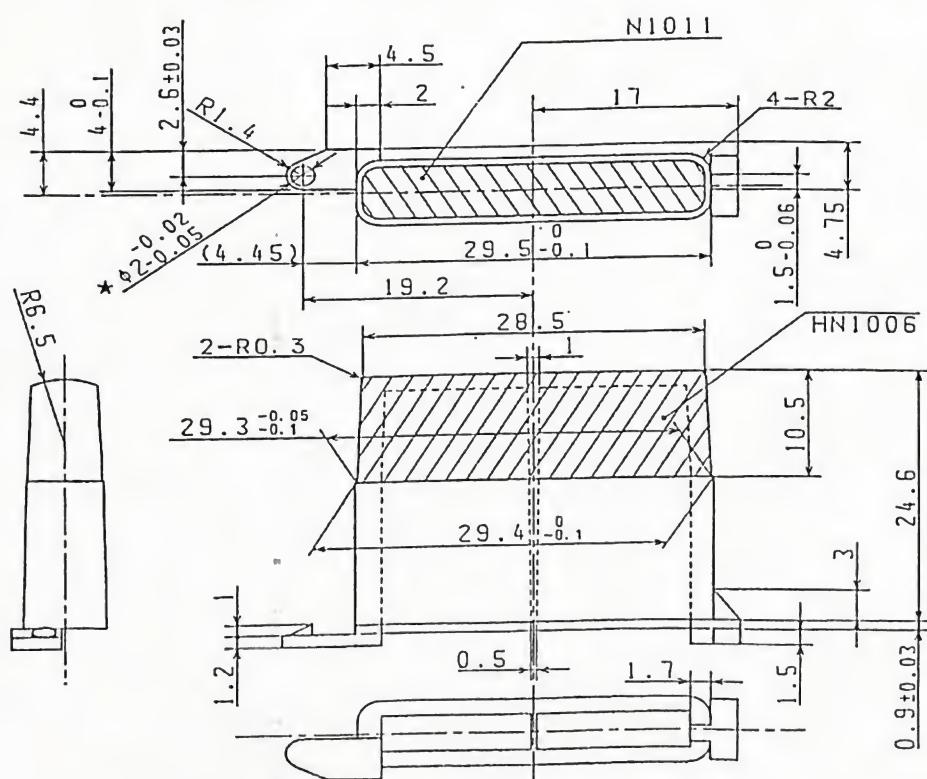

FIGURE 4 - EJECT BUTTON DIMENSIONS

| Commodore	TITLE			
	FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH			
SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 7 OF 21
	313372	1		
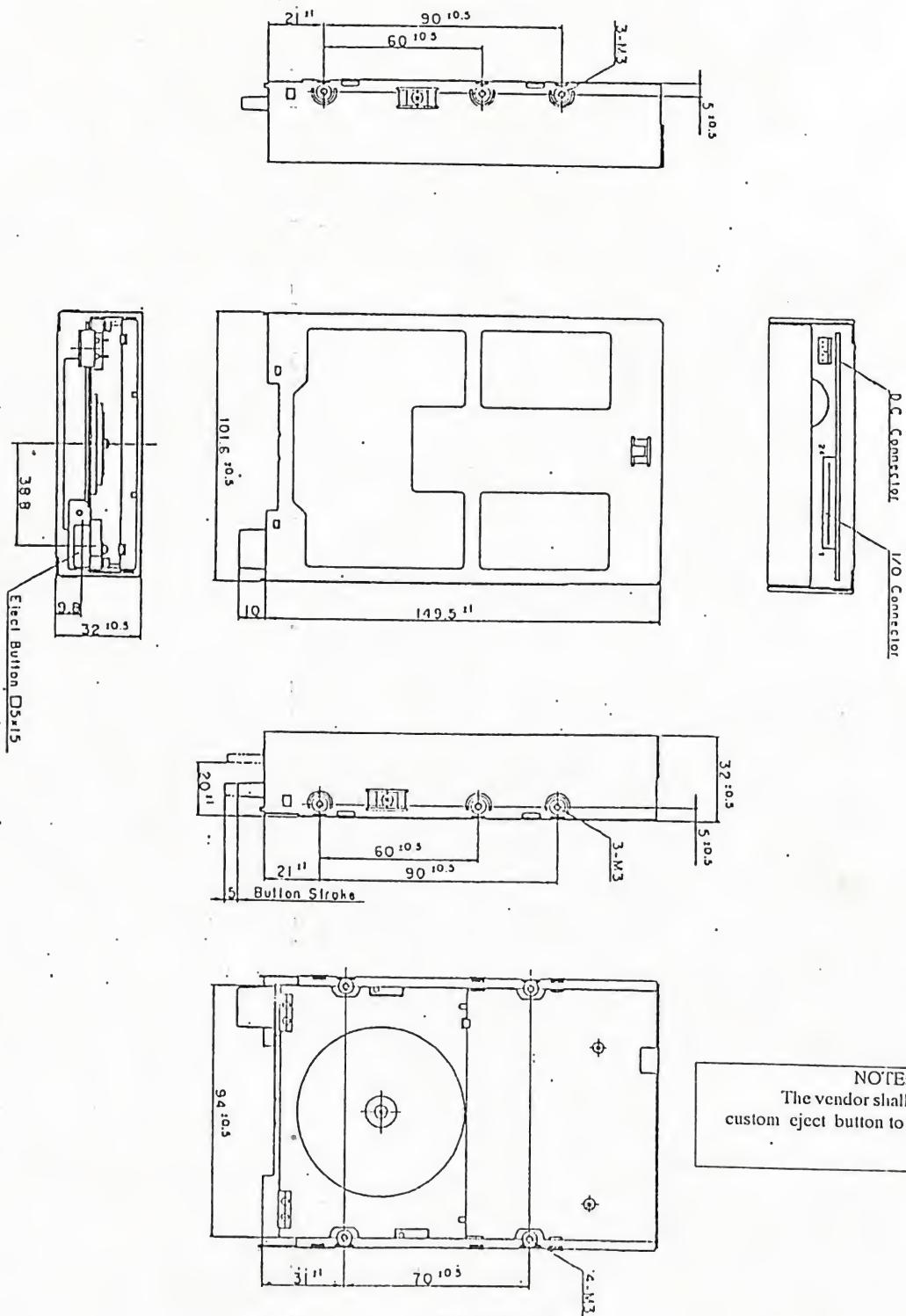
FIGURE 5
DRIVE DIMENSIONS

NOTE:
The vendor shall supply a
custom eject button to fit C65 casework

Commodore

TITLE

FLEXIBLE DISK DRIVE, 1Mb,
UNFORMATTED, 3.5 INCH

SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 8 OF 21
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2.4.3 Power-On SEQUENCE

Some drives move the head to position 0 on power-on. This is allowed, but not required.

3.0 ELECTRICAL REQUIREMENTs

3.1 POWER and CURRENT

Refer to Table 5.

3.2 POWER SUPPLY INTERFACE

Refer to table 5.

3.3 I/O INTERFACE

Refer to table 7 for the applicable Interface Connector Configuration.

3.4 SIGNAL VOLTAGE LEVELS

The signal voltage shall engage the disk drive controller at the TTL level. For all I/O signals, LOW shall be the active level.

The input signal level shall be: LOW level - 0.00V to +0.8V HIGH level - +2.00V to +5.25V

The output signal level shall be: LOW level - 0.00V to +0.40V HIGH level - +2.4V to +5.25v

The output current shall be 48mA max. (LOW level) and 250μA (HIGH level). The input impedance shall be 1K ohms min.

3.5 INPUT SIGNALS

DRIVE SELECT 0 to 3 lines:

The drive select feature is not used.

MOTOR-ON signal line:

This line controls the ON/OFF state of the spindle motor. when set to LOW level, the spindle motor operates. When set to HIGH level, the motor stops. 0.5 seconds (max) is the required start-up time for the spindle motor. This signal functions independently of the DRIVE SELECT signals.

It is preferred, but not required, that the Motor-On signal be ignored if no disk is inserted.

DIRECTION SELECT signal line:

This signal determines the direction of head movement when a pulse is detected on the STEP signal line. When set to LOW level and a STEP signal pulse is detected, the head moves toward the disk center. When set to HIGH level and the STEP signal is detected, the head moves out from the disk center. The logic level of this signal will be retained no less than one (1) microsecond after the trailing edge of the STEP pulse.

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STEP signal line:

This signal line controls the head movement. The drive head will step in the direction selected by the DIREC-TION SELECT signal when the STEP signal changes from LOW to HIGH level.

The head must be stabilized within 18ms (max) after the trailing edge of the last STEP pulse.

STEP pulses shall not cause head motion if DIRECTION is outward, and the Track "00" detect is already active.

It is preferred that head step be disabled if Track "00" is active and there is no disk inserted.

WRITE GATE signal lines:

This signal line specifies the write and read status. When this signal line is set to LOW level, a write-enable status occurs and the data is stored on the disk surface by the WRITE DATA signal. When this signal line is set to HIGH level, a read-status occurs. After the writing operation, there is a maximum delay of 1.2 mS before a valid READ DATA signal appears on the interface.

WRITE DATA signal line:

Data written to the disk is transferred by the write data signal line. With the decline of the pulse on this signal line (when the signal line changes from HIGH level to LOW level), data is written to the disk.

SIDE (0/1) SELECT signal line:

This line selects the appropriate head. When this signal line is set to HIGH level, the side "0" head shall be selected; When set to LOW level, side "1" head is selected. Side "0" indicates the single sided R/W surface. The operation is complete 100 microseconds (max) after the change of the SIDE SELECT signal line.

IN USE signal line:

The LED indicator glows when this signal line is set to LOW level. This signal line operates regardless of the DRIVE SELECT signals.

At the vendors option, the Motor-On signal (pin 16) may be used instead of IN USE.

3.6 OUTPUT SIGNALS

These signal are to be driven by open collector outputs. They must return to the high state when the drive is not selected. As an alternate method to open collectors a tristatable driver can be used, and the outputs tristated when the drive is not selected. See appendix A for the recommended interface circuit.

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INDEX signal line:

When one (1) rotation of the disk occurs, this signal line outputs a LOW level pulse indicating the beginning of the track. A decline in the pulse signal (when this signal line changes from HIGH level to LOW level) indicates the beginning of the track.

TRACK "00" signal line:

When this signal line is set to LOW level, it indicates that the head is located at track "00" position.

WRITE PROTECT signal line

When this signal line is LOW it indicates the disk cannot be written to. At the vendor's option, this signal line may also be set to LOW level when no disk is positioned in the drive. The write function must become inoperative when a write-protected disk is inserted.

READ DATA signal line:

This is the amplified, pulse shaped data that has been read from the disk media.

READY signal line:

The drive must set this line low when it is ready to receive Read and Write operations. Typically this signal will be set when the drive motor is known to be operating at full speed. After setting the MOTOR ON signal, the host will wait until the ready signal is LOW before attempting Read or write operations. The signal shall go high when the drive can not accept data.

DISK CHANGE signal:

This signal line is set to LOW level, by POWER-ON or when a disk is ejected, and is set to HIGH level by a STEP pulse input when a disk is present. If no disk is present the input of a STEP pulse will not change the state of DISK CHANGE.

Ground:

Frame (chassis) ground and signal ground shall be established through a 0.01 uf capacitor and a 100K ohm resistor. Frame ground shall be connected where AC ground and DC ground are common in the host system. An appropriate FDD ground lug shall be provided by the Vendor.

Power Supply Requirement (Host):

Power surges of 90% shall not exceed 100ms duration. Should the FDD power supply be disconnected during a status other than a write operation, data stored on the disk shall not be lost. However, should the WRITE GATE not be set HIGH, disk contents will be lost.

3.7 CABLE CONNECTOR - RECOMMENDED

The FDD assembly requires one (1) connector.

Commodore		TITLE		FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH
SIZE	DRAWING NUMBER 313372	REV. 1	SCALE	SHEET 12 OF 21

TABLE 5 - POWER and CURRENT REQUIREMENTS

Power Supply	DC+12V ±5%			
	DC+5V ±5%			
Power Consumption		5V	12V	POWER
	Standby	60 mA TYP	12 mA MAX	0.44 W TYP
	Read	190 mA TYP	100 mA TYP	2.15 W TYP
	Write	200 mA TYP	120 mA TYP	2.44 W TYP
	Seek	120 mA TYP	300 mA TYP	4.20 W TYP
	Starting Current	100 mA TYP	400 mA MAX	5.30 W MAX
Ripple voltage allowance	DC + 12 V	Less than 150 mVp-p (including spike noise)		
	DC +5 V	Less than 100 mVp-p (including spike noise)		

Commodore	TITLE	
	FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH	

SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 13 OF 21
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4.0   ENVIRONMENTAL REQUIREMENTS

The FDD shall meet its specified performance requirements under the environmental conditions of Table 7; Temperature, Humidity, Vibration, Shock, and Noise.

TABLE 7 - ENVIRONMENTAL REQUIREMENTS

PARAMETER	REQUIREMENT
TEMPERATURE Operational: Storage: Change rate:	+5 to +50 degrees C -20 to +60 degrees C (-40 C to +60 C in-transit) 10 °C per Hour (operational)
HUMIDITY Operational: Storage:	20% to 80% RH maximum wet bulb (at +29 degrees C) 5% to 90% RH no condensation 8% to 90% RH no condensation
VIBRATION Operational: Storage: (with HEAD Protector Installed)	FDD unit shall perform all read/write operations (no seek) according to specification, with continuous vibration of less than 0.6 g (+10%), from 5 Hz to 500 Hz (along the X, Y, Z plane). FDD unit, as packaged for shipment, shall withstand 3.0 g, from 5 Hz to 500 Hz, along each of three (3) mutually perpendicular axes.
SHOCK Operational: Non-Operational: In-Transit: (with HEAD Protector Installed)	Less than 5 g (10 ms) 1/2 sine wave Less than 30 g (10 ms) 1/2 sine wave Less than 60 g (10 ms) 1/2 sine wave
ACOUSTIC NOISE	40 dBA or less, at 1 meter, with a step rate of 3 ms and 4 ms per track.

Commodore	TITLE	FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH

SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 14 OF 21
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TABLE 6 - I/O CONNECTOR

PIN	DESCRIPTION
1	GND1
2	DSKIN*
3	DS*
4	MOT*
5	GND 5
6	DIR
7	STEP*
8	WD*
9	GND 9
10	WG*
11	NC
12	SIDE*
13	GND13
14	TRK0*
15	WPROT*
16	NC
17	GND17
18	RD*
19	GND19
20	GND20
21	VDD1
22	VDD2
23	VCC1
24	VCC2

Commodore

TITLE

FLEXIBLE DISK DRIVE, 1Mb,
UNFORMATTED, 3.5 INCH

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5.0 RELIABILITY REQUIREMENT

FDD shall meet or exceed the requirements specified in Table 8.

TABLE 8 - RELIABILITY REQUIREMENTS

DESCRIPTION	REQUIREMENT
MTBF:	10,000 hours - motor energized
MTTR:	0.5 hour
DRIVE LIFE:	5.0 years
ERROR RATE Soft: Hard: Seek:	1 per 10^9 bits or better 1 per 10^{12} bits or better 1 per 10^6 seeks or better
MEDIA MOUNTS Life:	30,000 cycles (minimum)
SEEK LIFE:	10 million cycles
HEAD LIFE:	10,000 hours (minimum)

5.1 TEST SUITE
Unit shall pass Commodore test suite for click test (seek with no disk) and resonance test.
(Commodore Part Number to be determined.)

Commodore

6.0 SAFETY REQUIREMENTS

6.1 REGULATORY STANDARDS

The FDD unit shall comply with the electrical requirements specified in Table 9, according to the applicable geographic area.

TABLE 9 - REGULATORY STANDARDS

STANDARD	DESCRIPTION
USA/Canada:	
UL 478	Electronic Data Processing Units and Systems
FCC Publ. 65	FCC Class B Part 15 - subpart J, Title 47, Part 15 -S
CSA 22.2	Data Processing Equipment, Consumer and Commercial Products
IEC 435	Data Processing Equipment

6.2 HAZARDOUS MATERIALS

No components containing Poly-Chlorinated Byphenyl (PCB) shall be used in this Floppy Disk Drive assembly.

Commodore	TITLE FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH		
SIZE	DRAWING NUMBER 313372	REV. 1	SCALE	SHEET 17 OF 21

7.0   REQUIRED DOCUMENTATION

The Vendor shall provide Commodore Business Machines (CBM) with the Service Manual. This Manual shall include a complete and current set of Electrical and Physical (Mechanical) Schematics, a complete and current part's List (Bill of Material) and an accurate and intelligible Assembly Service Directive. This Manual shall be suitable for CBM to properly support the floppy Disk Drive Assembly. All documents shall be legible and reproducible.

7.1   ENGINEERING CHANGES

Any changes to Form, Fit or Function shall be agreed to prior to implementation of these changes.

7.2   BAR CODE

The vendor shall affix a barcoded label(s) in accordance with Commodore Bar Code Specification # 310071.

SIZE	DRAWING NUMBER		REV.	SCALE	
		Commodore		TITLE	FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH
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Mounting position	Vertical Horizontal 15° MAX
	20° MAX Declination upward 0° Declination lowward
Media eject	10 mm or more in the above mounting positions
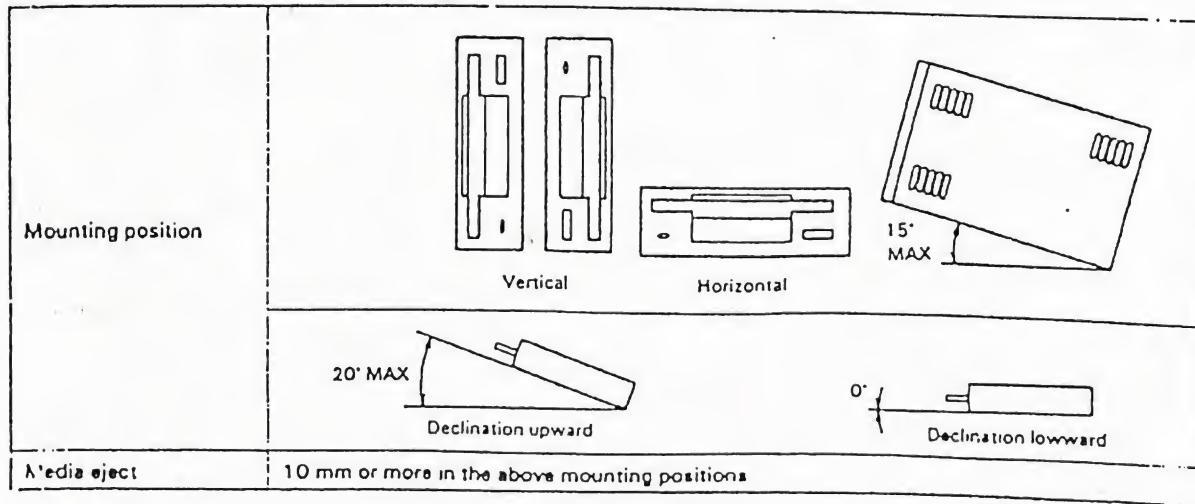
FIGURE 6
MOUNTING CONFIGURATION

Interface with the controller and host system

CONTROLLER SIDE   DRIVE SIDE

DRIVE   SELECT   0   3

SIDE SELECT   12

MOTOR   ON   4

DIRECTION   SELECT   6

STEP   7

WRITE   DATA   8

WRITE   GATE   10

14   TRACK   00

15   WRITE   PROTECT

18   READ   DATA

1. 5. 9. 13

DC GROUND   +12 V DC   21.22   SIGNAL   GROUND

RETURN 17.19.20   100 KΩ   0.01 μF

+   5 V DC   23. 24

FRAME   GROUND
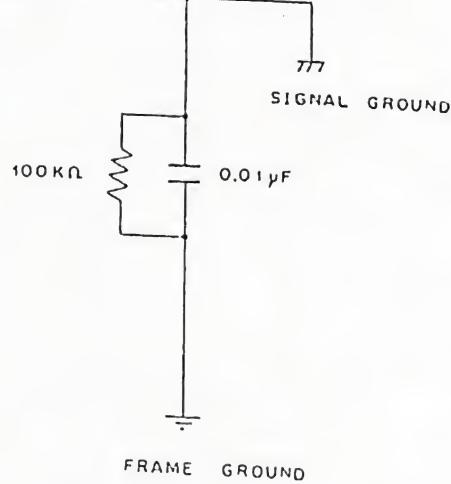
FIGURE 7
INTERFACE SIGNAL LINES

Commodore	TITLE	
	FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH	

SIZE	DRAWING NUMBER	REV.	SCALE	SHEET 20 OF 21
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33.55

31.11

5

(1.25)   (0.52)

(9)

(5.4)

(0.5)   3.3

(2.5)

8

31.25 ± 0.1

1.25 ± 0.2   28.75 ± 0.1   1.25 ± 0.2

0.30 ± 0.05   1.25 ± 0.25   0.8 ± 0.03

(10)

6 ± 1

Ⓐ

Ⓒ

Ⓑ

①   ㉔

CONSTITUENT ELEMENTS	
ITEM	DESCRIPTION
A	a conductor (tin or solder plate more than 2 mm thick)
B	an insulator
C	a reinforcement
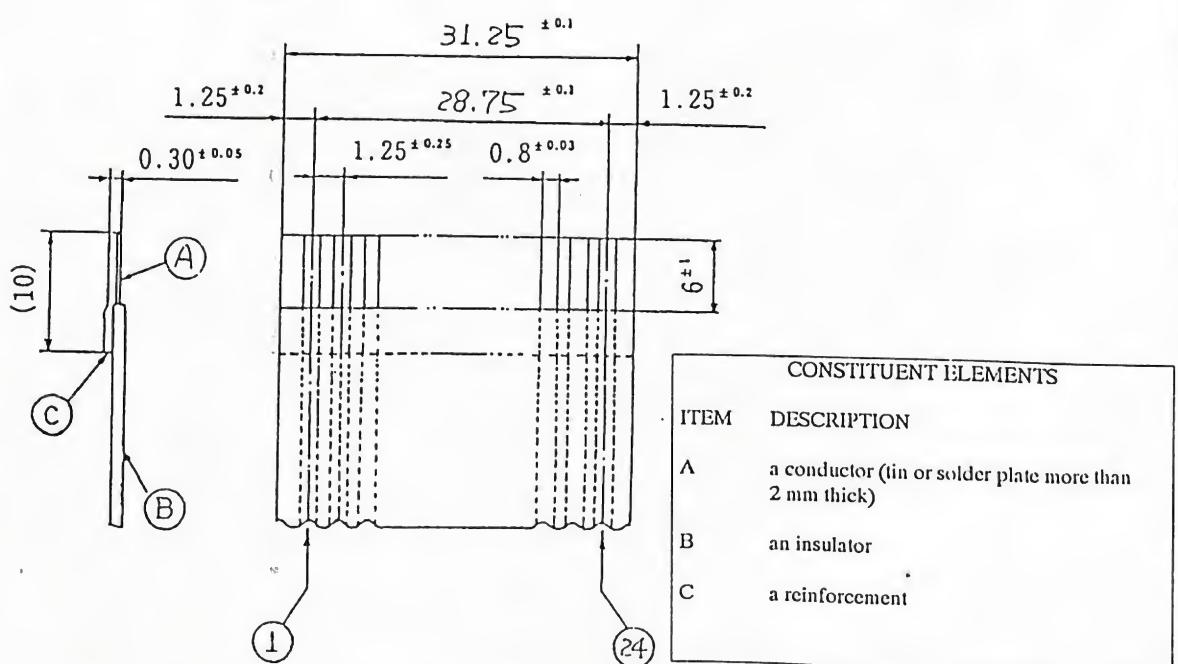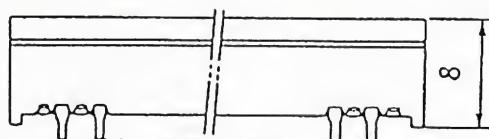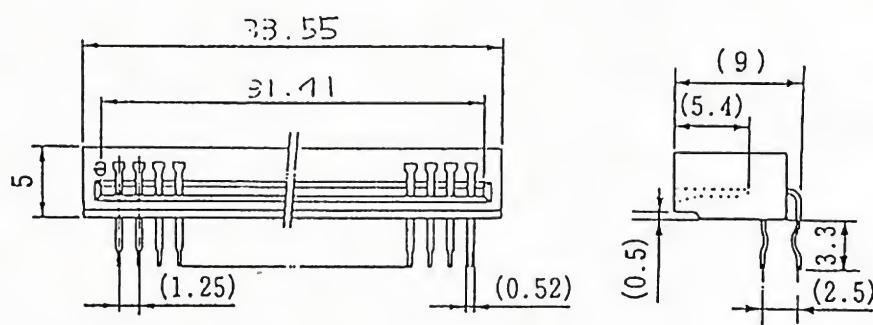
FIGURE 8
INTERFACE SIGNAL CONNECTOR DIMENSIONS

Commodore

APPROVED VENDOR LIST

This sheet must be removed from this document before the document is shown or transmitted to a vendor.

Commodore Part Number	Vendor	Vendor Part Number
313372-01	CHINON	FB354 C Rev. A

Commodore

TITLE

FLEXIBLE DISK DRIVE, 1Mb,
UNFORMATTED, 3.5 INCH

SIZE	DRAWING NUMBER	REV.	SCALE	SHEET i OF ii
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PROCUREMENT SPECIFICATION

This sheet must be removed from this Part Specification document before the document is shown or transmitted to a vendor.

REVISION: A
USED ON: C65
AS CPN: 313372-01

VENDOR PRODUCT INFORMATION

1.   DEVICE IDENTIFICATION

    ·   VENDOR   CHINON
        PRODUCT DESCRIPTION   3.5 Floppy Disk Drive
        MODEL NUMBER   FB354 C Rev. A
        TOP ASSEMBLY NUMBER
        PCB:
        PCBA:
        FIRMWARE:

2.   VENDOR DOCUMENTATION

        PRODUCT MANUAL
        PRODUCT SPECIFICATION
        SCHEMATIC

3.   OPTIONS:

4.   LOCATION OF MANUFACTURE (Top Assembly)

        Country
        Facility
        Lines

5.   COMMENTS:

	Commodore	TITLE			
		FLEXIBLE DISK DRIVE, 1Mb, UNFORMATTED, 3.5 INCH			
SIZE	DRAWING NUMBER	REV.	SCALE		SHEET ii OF ii
	313372	1			